

WHAT IS CLAIMED IS:

1. An apparatus for measuring physiological pressure comprising:
a pressure transmission catheter filled with a pressure transmitting medium and implantable in an area having a physiological pressure;
a connecting catheter carrying electrical wires;
a transducer coupled to the electrical wires and in communication with the pressure transmitting medium to provide a pressure signal representing variations in the physiologic pressure on the electrical wires;
signal processing and telemetry circuitry coupled to the electrical wires to receive the pressure signal and provide a telemetry signal representing the pressure signal; and
a housing holding the signal processing and telemetry circuitry, wherein the transducer is remote from the housing.
2. The apparatus of claim 1 wherein the pressure transmission catheter has a length short enough to avoid significant head pressure artifact and provide sufficient dynamic response.
3. The apparatus of claim 2 where the length of the pressure transmission catheter is long enough to accommodate surgical limitations and tolerance concerns.
4. The apparatus of claim 1 wherein the pressure transmission catheter has a length in the range from approximately two millimeters to approximately four centimeters.
5. The apparatus of claim 1 wherein the pressure transmitting medium comprises a gel.

6. The apparatus of claim 1 wherein the pressure transmitting medium comprises a gel and a low-viscosity liquid.
7. The apparatus of claim 1 wherein the pressure transmitting medium comprises a slidable plug and a low-viscosity liquid.
8. The apparatus of claim 1 wherein the transducer is pre-temperature compensated and disposable.
9. The apparatus of claim 1 further comprising a sensor for measuring a temperature of the transducer to be provided to a computing device for compensating the temperature.
10. The apparatus of claim 1 wherein the housing is implantable remote from the area having the physiological pressure.
11. The apparatus of claim 1 wherein the signal processing and telemetry circuitry transmits the telemetry signal to an external receiver.
12. The apparatus of claim 1 wherein the apparatus can be employed to measure venous pressure, pulmonary pressure, bladder pressure, or intracranial pressure without significant head pressure artifact and with a sufficient dynamic response.
13. The apparatus of claim 1 wherein the pressure transmission catheter includes:
 - a lumen filled with the pressure transmitting medium;
 - an inner layer material surrounding the lumen; and
 - an outer layer material surrounding the inner layer material, wherein the outer layer material has a different hardness than the inner layer material.

14. The apparatus of claim 13 wherein the inner layer material is harder than the outer layer material.

15. An apparatus for measuring physiological pressure comprising:

a pressure transmission catheter filled with a pressure transmitting medium and having a distal tip for placement in an area having a physiological pressure and a proximal end;

a connecting catheter carrying electrical wires;

a transducer coupled to the electrical wires and in communication with the pressure transmitting medium at the proximal end of the pressure transmission catheter to provide a pressure signal representing variations in the physiologic pressure on the electrical wires;

signal processing circuitry coupled to the electrical wires to process the pressure signal; and

wherein a distance between the distal tip and the proximal end of the pressure transmission catheter is sufficiently short to avoid significant head pressure artifact and provide sufficient dynamic response yet sufficiently long to accommodate surgical limitations and tolerance concerns in applications for measuring physiological pressures where, if a length of the pressure transmission catheter was the combined length of the pressure transmission catheter and the connecting catheter, there would be a significant head pressure artifact and/or an insufficient dynamic response.

16. The apparatus of claim 15 further comprising:

a housing holding the signal processing circuitry, wherein the transducer is remote from the housing.

17. The apparatus of claim 16 further comprising:
telemetry circuitry in the housing coupled to the signal processing circuitry to provide a telemetry signal representing the pressure signal.
18. The apparatus of claim 15 wherein the distance between the distal tip and the proximal end of the pressure transmission catheter is in the range from approximately two millimeters to approximately four centimeters.
19. The apparatus of claim 15 wherein the pressure transmitting medium comprises a gel.
20. The apparatus of claim 15 wherein the pressure transmitting medium comprises a gel disposed at the distal tip and a low-viscosity liquid from the gel to the proximal end.
21. The apparatus of claim 15 wherein the pressure transmitting medium comprises a slidable plug disposed at the distal tip and a low-viscosity liquid from the slidable plug to the proximal end.
22. The apparatus of claim 15 wherein the transducer is pre-compensated and disposable.
23. The apparatus of claim 15 wherein the housing is implantable remote from the area having the physiological pressure.
24. The apparatus of claim 15 wherein the signal processing and telemetry circuitry transmits the telemetry signal to an external receiver.

25. The apparatus of claim 15 wherein the apparatus can be employed to measure venous pressure, pulmonary pressure, bladder pressure, or intracranial pressure without significant head pressure artifact and with a sufficient dynamic response.

26. The apparatus of claim 15 wherein the pressure transmission catheter includes:

- a lumen filled with the pressure transmitting medium;
- a inner layer material surrounding the lumen; and
- an outer layer material surrounding the inner layer material, wherein the outer layer material has a different hardness than the inner layer material.

27. The apparatus of claim 26 wherein the inner layer material is harder than the outer layer material.

28. An apparatus for measuring physiological pressure comprising:

- a pressure transmission catheter filled with a pressure transmitting medium and having a distal tip for placement in an area having a physiological pressure and a proximal end, wherein a distance between the distal tip and the proximal end is sufficiently short to avoid significant head pressure artifact and provide sufficient dynamic response yet sufficiently long to accommodate surgical limitations and tolerance concerns;

- a connecting catheter carrying electrical wires;

- a transducer coupled to the electrical wires and in communication with the pressure transmitting medium at the proximal end of the pressure transmission catheter to provide a pressure signal representing variations in the physiologic pressure on the electrical wires;

- signal processing circuitry coupled to the electrical wires to process the pressure signal; and

a housing holding the signal processing circuitry, wherein the transducer is remote from the housing.

29. The apparatus of claim 28 further comprising:

telemetry circuitry in the housing coupled to the signal processing circuitry to provide a telemetry signal representing the pressure signal.

30. The apparatus of claim 28 wherein the distance between the distal tip and the proximal end of the pressure transmission catheter is in the range from approximately two millimeters to approximately four centimeters.

31. The apparatus of claim 28 wherein the pressure transmitting medium comprises a gel.

32. The apparatus of claim 28 wherein the pressure transmitting medium comprises a gel disposed at the distal tip and a low-viscosity liquid from the gel to the proximal end.

33. The apparatus of claim 28 wherein the pressure transmitting medium comprises a slidable plug disposed at the distal tip and a low-viscosity liquid from the slidable plug to the proximal end.

34. The apparatus of claim 28 wherein the transducer is pre-compensated and disposable.

35. The apparatus of claim 28 wherein the housing is implantable remote from the area having the physiological pressure.

36. The apparatus of claim 29 wherein the signal processing and telemetry circuitry transmits the telemetry signal to an external receiver.

37. The apparatus of claim 28 wherein the apparatus can be employed to measure venous pressure, pulmonary pressure, bladder pressure, or intracranial pressure without significant head pressure artifact and with a sufficient dynamic response.

38. The apparatus of claim 28 wherein the pressure transmission catheter includes:

- a lumen filled with the pressure transmitting medium;
- a inner layer material surrounding the lumen; and
- an outer layer material surrounding the inner layer material, wherein the outer layer material has a different hardness than the inner layer material.

39. The apparatus of claim 38 wherein the inner layer material is harder than the outer layer material.

40. A pressure transmitting catheter implantable in an area having a physiological pressure, the pressure transmitting catheter comprising:

- a lumen filled with a pressure transmitting medium;
- a inner layer material surrounding the lumen; and
- an outer layer material surrounding the inner layer material, wherein the outer layer material has a different hardness than the inner layer material.

41. The apparatus of claim 40 wherein the inner layer material is harder than the outer layer material.

42. The pressure transmitting catheter of claim 40 wherein a transition between the inner layer material and the outer layer material is a sharp transition.

43. The pressure transmitting catheter of claim 40 wherein a transition between the inner layer material and the outer layer material is a gradient transition.

44. The pressure transmitting catheter of claim 40 wherein the harder one of the inner and outer layer materials essentially determines the frequency response of the pressure transmitting catheter and the softer one of the inner and outer layer materials makes the pressure transmitting catheter more flexible and kink resistant.

45. The pressure transmitting catheter of claim 40 wherein the inner layer material comprises 72 D urethane and the outer layer material comprises 80 A urethane.

46. The pressure transmitting catheter of claim 40 wherein an outer diameter of the pressure transmitting catheter is in a range from approximately .014 to approximately .022 inches, the inner diameter of the lumen is less than approximately .008 inches, and the combined thickness of the inner material and outer material is less than approximately .005 inches.

47. The pressure transmitting catheter of claim 46 wherein the thickness of the inner material is less than approximately .002 inches.

48. The pressure transmitting catheter of claim 40 wherein the inner layer material comprises a radiopaque material.

49. The pressure transmitting catheter of claim 48 wherein the inner layer material comprises an approximately 20-30% barium filled urethane.

50. The pressure transmitting catheter of claim 48 wherein the outer layer material comprises non-thrombogenic material.

51. An apparatus for measuring physiological pressure comprising:
a pressure transmission catheter implantable in an area having a physiological pressure and including:
a lumen filled with a pressure transmitting medium,
an inner layer material surrounding the lumen, and
an outer layer material surrounding the inner layer material, wherein the outer layer material has a different hardness than the inner layer material;
a connecting catheter carrying electrical wires;
a transducer coupled to the electrical wires and in communication with the pressure transmitting medium to provide a pressure signal representing variations in the physiologic pressure on the electrical wires;
signal processing circuitry coupled to the electrical wires to process the pressure signal; and
a housing holding the signal processing circuitry, wherein the transducer is remote from the housing.

52. The apparatus of claim 51 wherein the inner layer material is harder than the outer layer material.

53. The apparatus of claim 51 wherein the pressure transmission catheter has a distal tip for placement in the area having a physiological pressure and a proximal end coupled to the transducer, and wherein a distance between the distal tip and the

proximal end is sufficiently short to avoid significant head pressure artifact and provide sufficient dynamic response yet sufficiently long to accommodate surgical limitations and tolerance concerns.

54. An apparatus for measuring physiological pressure comprising:
- a pressure transmission catheter filled entirely with a pressure transmitting gel and implantable in an area having a physiological pressure;
 - a connecting catheter carrying electrical wires;
 - a transducer coupled to the electrical wires and in communication with the pressure transmitting gel to provide a pressure signal representing variations in the physiologic pressure on the electrical wires;
 - signal processing and telemetry circuitry coupled to the electrical wires to receive the pressure signal and provide a telemetry signal representing the pressure signal; and
 - a housing holding the signal processing and telemetry circuitry and the transducer.
55. The apparatus of claim 54 wherein the pressure transmission catheter includes:
- a lumen filled with the pressure transmitting gel;
 - an inner layer material surrounding the lumen; and
 - an outer layer material surrounding the inner layer material, wherein the outer layer material has a different hardness than the inner layer material.
56. The apparatus of claim 55 wherein the inner layer material is harder than the outer layer material.

57. An apparatus for measuring physiological pressure comprising:
a pressure transmitting catheter having a lumen filled with a pressure transmitting medium;
a transducer in communication with the pressure transmitting medium to provide a pressure signal representing variations in the physiological pressure on an electrical wire;
signal processing circuitry coupled to the electrical wire to process the pressure signal; and
a housing holding the signal processing circuitry and the transducer;
wherein the pressure transmitting catheter includes a first layer material surrounding the lumen and at least one additional layer of material surrounding the first layer material, wherein the at least one additional layer of material has at least one material with a different hardness than the first layer of material.
58. The apparatus of claim 57 wherein the pressure transmitting medium comprises a gel.
59. The apparatus of claim 57 wherein the pressure transmitting medium comprises a gel and a low-viscosity liquid.
60. The apparatus of claim 57, wherein the lumen is filled entirely with a pressure transmitting gel.
61. The apparatus of claim 57 further comprising telemetry circuitry located in the housing and coupled to the signal processing circuitry to provide a telemetry signal representing the pressure signal.

62. The apparatus of claim 61 wherein the telemetry circuitry transmits the telemetry signal to an external receiver.

63. The apparatus of claim 57 wherein the apparatus can be employed to measure arterial pressure, venous pressure, pulmonary pressure, bladder pressure, left ventricle pressure, or intracranial pressure.

64. An apparatus for measuring physiological pressure comprising:
a pressure transmission catheter having a lumen filled entirely with a pressure transmitting gel and implantable in an area having a physiological pressure;
a transducer in communication with the pressure transmitting gel and coupled to an electrical wire to provide a pressure signal representing variations in the physiologic pressure on the electrical wire;
signal processing circuitry coupled to the electrical wire to receive the pressure signal and provide a signal representing the pressure signal; and
a housing for holding the signal processing circuitry and transducer.

65. The apparatus of claim 64, wherein the pressure transmitting catheter includes a first layer material surrounding the lumen and at least one additional layer of material surrounding the first layer material, wherein the at least one additional layer of material has at least one material with a different hardness than the first layer of material.

66. The apparatus of claim 64, wherein the pressure transmitting catheter is flexible.

67. The apparatus of claim 64 further comprising telemetry circuitry located in the housing and coupled to the signal processing circuitry to provide a telemetry signal representing the pressure signal.

68. The apparatus of claim 67 wherein the telemetry circuitry transmits the telemetry signal to an external receiver.

69. An apparatus for measuring physiological pressure comprising:

a pressure transmission catheter having a lumen filled with a pressure transmitting medium and implantable in an area having a physiological pressure;

a transducer in communication with the pressure transmitting medium and coupled to an electrical wire for providing a signal representing variations in the physiologic pressure on the electrical wire; and

a connecting catheter carrying the electrical wire to a location remote from the transducer.

70. The apparatus of claim 69 wherein the pressure transmission catheter has a length short enough to avoid significant head pressure artifact and provide sufficient dynamic response.

71. The apparatus of claim 69 wherein the length of the pressure transmission catheter is long enough to accommodate surgical limitations and tolerance concerns.

72. The apparatus of claim 69 wherein the pressure transmission catheter has a length in the range from approximately two millimeters to approximately four centimeters.

73. The apparatus of claim 69 wherein the pressure transmitting medium comprises a gel.

74. The apparatus of claim 69 wherein the pressure transmitting medium comprises a gel and a low-viscosity liquid.

75. The apparatus of claim 69 wherein the pressure transmitting medium comprises a slidable plug and a low-viscosity liquid.

76. The apparatus of claim 69 wherein the pressure transmitting medium comprises only a gel which fills the entire lumen.

77. The apparatus of claim 69 wherein the pressure transmitting catheter includes a first layer material surrounding the lumen and at least one additional layer of material surrounding the first layer material, wherein the at least one additional layer of material has at least one material with a different hardness than the first layer of material.

78. The apparatus of claim 69 further comprising signal processing and telemetry circuitry coupled to the electrical wire to receive the pressure signal and provide a telemetry signal representing the pressure signal.

79. The apparatus of claim 78, wherein the signal processing and telemetry circuitry transmits the telemetry signal to an external receiver.

80. The apparatus of claim 78, wherein the signal processing and telemetry circuitry is located within a housing and wherein the housing is remote from the transducer.

81. An apparatus for measuring physiological pressure comprising:
a pressure transmission catheter having a lumen filled entirely with a pressure transmitting gel and implantable in an area having a physiological pressure; and
a transducer in communication with the pressure transmitting gel and coupled to an electrical wire to provide a signal on the electrical wire which represents variations in the physiologic pressure.

82. The apparatus of claim 81, wherein the pressure transmitting catheter includes a first layer material surrounding the lumen and at least one additional layer of material surrounding the first layer material, wherein the at least one additional layer of material has at least one material with a different hardness than the first layer of material.

83. The apparatus of claim 81, further comprising signal processing and telemetry circuitry coupled to the electrical wire to receive the pressure signal and provide a telemetry signal representing the pressure signal.

84. The apparatus of claim 83, further comprising a housing holding the signal processing and telemetry circuitry and transducer.

85. The apparatus of claim 81, wherein the electrical wire is carried within a connecting catheter carrying the electrical wire to a location remote from the transducer.

86. The apparatus of claim 85, wherein the pressure transmission catheter has a length short enough to avoid significant head pressure artifact and provide sufficient dynamic response.

87. The apparatus of claim 85, wherein the pressure transmission catheter has a length in the range from approximately two millimeters to approximately four centimeters.

88. The apparatus of claim 85, wherein the length of the pressure transmission catheter is long enough to accommodate surgical limitations and tolerance concerns.

89. The apparatus of claim 85, further comprising signal processing and telemetry circuitry coupled to the electrical wire to receive the pressure signal and provide a telemetry signal representing the pressure signal.

90. The apparatus of claim 89, wherein the telemetry circuitry transmits the telemetry signal to an external receiver.